Prof. Burdon Sanderson is treating of the Nervous System, and Prof. Bayley Balfour of the Algæ.

Dr. Tylor is giving Anthropological Elucidations of Greek and Latin authors, and the Reader in Geography is continuing the courses which he began last term.

The Professorship of Geology is to be filled up in the course of this term: applications will be received by the Registrar up to February 1.

The Radcliffe Fellowship will be awarded this term; also the Burdett-Coutts Scholarship, as soon as the Professor of Geology is appointed.

The number of men reading Medicine is steadily increasing, and now that it is possible for a man to pass his B.A. examinations and his first M.B. examination in four years, there can be little doubt that the increase will continue.

CAMBRIDGE.—Mr. H. D. Rolleston, B.A., M.B., of St. John's College, has been appointed Demonstrator of Pathology.

Sir F. A. Abel, F.R.S., has been appointed to deliver the Rede Lecture this year.

The Disney Professor (the Rev. G. F. Browne) will lecture on Tuesdays this term on Sculptured Stones of pre-Norman type in the British Islands. The inaugural lecture will be given in the Senate House on January 31.

Dr. F. Warner's lectures on the Growth and Development of the Intellectual Faculty began on January 25. The lectures aim at describing and analyzing the action of the brain of a child, with special application to educational methods.

SCIENTIFIC SERIALS.

THE most important article in the numbers of the *Journal of Botany* for December 1887 and January 1888 is one by Mr. S. Le M. Moore, "On Epidermal Chlorophyll," in which he shows that the presence of chlorophyll-corpuscles in the cells of the epidermis is of much more common occurrence than is usually stated in text-books, and that these chlorophyll-corpuscles very commonly contain starch-grains. The other articles relate to botanical nomenclature and to the distribution of British plants. In addition, Mr. J. G. Baker continues his "Monograph of the Tillandsieæ," and Colonel Beddome contributes a paper on Ferns of Perak and Penang.

IN the *Botanical Gazette* (Crawfordsville, Indiana) for December 1887 is an interesting paper by Mr. Byron D. Halsted, showing that under certain conditions pollen-grains may contain three nuclei, instead of the two usually found in them.

Bulletin de l'Académie Royale de Belgique, November 1887.—Action of the acids on the taste, by J. Corin. The object of these researches has been to ascertain what relation there may exist between the acid taste and chemical composition. The author arrives at the curious result that acidity increases with the quantity of basic hydrogen contained in the acid molecule, and decreases with the weight of the molecule itself.—Physical observations on Saturn, by Paul Stroobant. These observations, extending over the period from January 27 to April 20, 1887, show that the famous divisions of Encke and Struve appear to be subject to great modifications, especially as regards the actual position occupied by them. No doubt the state of the terrestrial atmosphere, the proximity of the moon, and other outward circumstances, must exercise a considerable influence on the character of the manifestations. But the changes here recorded, such as the disappearance of Encke's division while that of Struve is still visible, make it evident that other and more recondite causes are at work in producing these shifting appearances.—Experimental researches on the sense of vision in the Arthropods (second part), by Felix Plateau. In this section the author passes from a study of the Myriapods to that of the higher order of the Arachnidæ, and arrives at the general conclusion that in all the sub-groups of the Spiders, Scorpions, and Phalangidæ the visual sense is very feebly developed. They exhibit in general a vague perception of movement acting on their nervous system, rather than a clear sight of any definite object. In the case of *Epiblemum scenicum*, distinct vision does not seem to extend beyond a distance of 1 centimetre, while *Tegenaria domestica* and others seem unable to distinguish form at all. Even in the closest proximity they rush with equal avidity on true or false objects of prey. The scorpions also show little evidence of sight, shunning the light and awaiting, rather than pursuing, their prey, which they fail to detect except at very short distances. The same remark applies to the Phalangidæ, which compensate the defect of vision by the exquisite tactile sense of their extremities.

Rivista Scientifico-Industriale, November 1887.—On the heating of metallic points when discharging their electricity, by Prof. Eugenio Semmola. Some experiments are described scientifically demonstrating the fact that heat is generated while metallic points discharge their electricity, the points themselves becoming at the same time heated. It is suggested that this fact, now for the first time verified, might under certain conditions be utilized as a new means of studying atmospheric electricity.—On the anæsthesis and poisoning of plants, by Dr. Flaminio Tassi. An analysis is given of the researches and experiments carried out by Prof. T. Caruel, tending to show that certain plants really possess a property analogous to the irritability, excitability, sensitiveness, or contractibility of animals, as it is variously called; that this property is not derived from any particular nervous system, but from the vegetable protoplasm itself; that certain organic substances are alike fatal to plants and animals; and that a state resembling animal anæsthesis is also produced especially in those plants which are endowed with excitable organs, and in many flowers that open and close at fixed times.

THE last two parts of vol. xviii. of the *Izvestia* of the East Siberian branch of the Russian Geographical Society contain a variety of valuable information. In a paper on the lower course of the Upper Angara, Dr. Kiriloff brings together some interesting facts about the fishing in Lake Baikal, which, notwithstanding complaints about the disappearance of the *Salmo omul*, still yields every year about 30,000 cwt. of fish. MM. Priklonsky and Slyeptsoff contribute notes on the religious beliefs of the Yakutes, who, although christened, have retained in full their Shamanist religion and practices. M. Karpinsky gives some notes on the gold-diggings of the Olekma system. Especially valuable papers are contributed by M. Savenkoff, on his archæological researches on the Yenisei, and by M. Eleneff on the caves on the banks of the Biryusa River. It would be impossible to enumerate in a short note all the interesting data mentioned in M. Savenkoff's preliminary report. His numerous collections contain, among other things, big bones of the mammoth and the rhinoceros, which bear unmistakable traces of having been broken by man for the sake of the marrow, and thus belong to the very rare relics of the Palæolithic period in Siberia. His collections also include bones with grooves for the insertion of a stone arrow-head, and many interesting implements, showing that stone implements were largely used during the Bronze Age, and partly during the Iron Age. The full report of M. Savenkoff, which will contain accurate drawings of the Yenisei inscriptions, will be most valuable. As to the exploration of caverns on the banks of the Biryusa and the Yenisei, M. Eleneff gives only a short description of his diggings, with detailed drawings and lists of the implements and various things found: Chinese money from the thirteenth or fourteenth century in the upper layers, various iron implements in the middle layers, and Neolithic stone implements in the lowest layers. The same parts of the *Izvestia* contain preliminary reports about an excursion to Lake Kosogol and the Munku-Sardyk, by MM. Prein and Yaczewski, during which excursion the glacier of this peak was thoroughly mapped and photographed, and large collections of Alpine flora were gathered.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 22, 1887.—"Heat Dilatation of Metals from Low Temperatures." By Thos. Andrews, F.R.S.E.

The experiments of this paper were made to approximately determine the coefficients of heat dilatation of modern steels from low temperatures. The metals employed were wrought iron, "soft" Bessemer steel, "hard" Bessemer steel, "soft" Siemens-Martin steel, "hard" Siemens-Martin steel, "soft" cast steel, "hard" cast steel, &c., of known composition, specific gravity, &c., given in detail in the paper. The terms "soft" and "hard" relate only to difference of percentage of combined carbon. The ranges of temperature chosen for the observations were from $-45°$ C. to $300°$ C. The experiments were made on rolled bars of the various steels and also on large hammered forgings 5 inches diameter. Details are given in the paper of the general method of experimentation, and also of the methods adopted for reducing the metals to the very low temperature employed. The results of an extensive series of experiments are recorded in tabular form in the paper. The coefficients of dilatation were found generally to decrease with the reduced temperature. The author also found such to be the case in his recent observations on the heat dilatation of pure ice from low temperatures. There seemed to be a slightly greater dilatation in the direction of the length of the forged metallic cylinders than when measured across the diameter. It was also noticed that the coefficients of dilatation were greater in the case of steels having a lower percentage of combined carbon than in those containing a higher percentage.

January 12.—"Invariants, Covariants, and Quotient Derivatives associated with Linear Differential Equations." By A. R. Forsyth, F.R.S.

The memoir deals with the covariantive forms associated with the general ordinary linear differential equation. The most general transformation to which such an equation can be subjected without changing its character is one whereby the dependent variable y is changed to u by a relation $y = u f(x)$, and at the same time the independent variable is changed, say, from x to z. When these transformations are effected there are n relations between the coefficients P and Q of the equation in its two forms, and it is shown that from these others can be deduced which are of the form

$$\psi(\mathrm{P}) = \left(\frac{dz}{dx}\right)^{\rho} \psi(\mathrm{Q}).$$

Such a function ψ is called an invariant of index ρ.

Irreducible invariants are proved to be divisible into two classes, fundamental and derived. Each of the former, which are $n-2$ in number, consists of two parts; one of these is linear in the quantities P and their derivatives, the other is not linear, but has in every term as a factor either P_2 or some derivative of P_2. It is shown that the differential equation can be reduced to a canonical form without any term in $\frac{d^{n-1}u}{dz^{n-1}}$ or $\frac{d^{n-2}u}{dz^{n-2}}$; and hence each of the prior class of invariants is linear in the coefficients of the canonical form and their derivatives. These fundamental invariants are called priminvariants. The derived invariants are obtained from the priminvariants by two processes, which are called the quadriderivative and the Jacobian; they are most conveniently arranged in classes according to their degrees in the coefficients of the equation. The number of quadrinvariants is $2n-5$; the number of invariants of every degree higher than the second is $n-2$.

The relation between the independent variables of a semi-canonical form and of the canonical form shows that the dependent variable may be considered as a covariant. It is proved that there are other $n-2$ associate dependent variables, each satisfying a linear equation and possessing for the canonical form the invariantive property.

From this aggregate of dependent variables, a set of irreducible identical covariants is derived by the two processes formerly used for the invariants; when the equation is taken in its canonical form, all these covariants up to a certain order involve the dependent variables alone. There is also a set of irreducible mixed covariants which are the Jacobians of each of the dependent variables in turn, and one of the invariants.

Illustrations of the results are given for the equations of the second, the third, and the fourth orders; and in this connection, functions, called quotient derivatives, are obtained. Some of their properties are given, one of the most important being that they are covariantive for homographic transformation of both the dependent and the independent variables.

Finally, the characteristic differential equations satisfied by all concomitants are obtained; and among other inferences it is proved that the aggregate of concomitants constituted by the invariants and covariants obtained in the earlier part of the memoir is complete, *i.e.* that any concomitant can be algebraically expressed in terms of the members of that aggregate.

"Preliminary Note on the Nephridia of Perichæta." By Frank E. Beddard, M.A.

The following observations are the result of a study of a species of Perichæta, which is probably identical with Perrier's *P. aspergillum*. I owe a number of excellently preserved examples to the kindness of Mr. Shipley, Fellow of Christ's College, Cambridge.

In transverse sections of the anterior segments the nephridia are seen to form numerous tufts of glandular tubules closely related to the body-wall and to the septa. This appearance, which is also seen in dissections, is very different from that of most earthworms, and has been commented upon by other observers.

The remarkable appearance of the nephridia led me to infer that I should find the external apertures in each segment to be numerous, as I showed to be the case in Acanthodrilus. I am now able to state that this is also the case in Perichæta (in all probability in other species besides *P. aspergillum*). The external pores lie between the setæ, but have no regularity in their arrangement; frequently there were three or four between two successive setæ, as often there seemed to be only one or two. The minute structure of the terminal section of nephridia is slightly different from that of Acanthodrilus. Another point, to which I wish to direct attention in this communication, is that *in Perichæta there is a connection between the nephridia of successive segments.*

Quite recently, Ed. Meyer and Cunningham have shown that in *Lanice conchilega* the nephridia of each side are connected by a continuous longitudinal duct. This discovery is in accord with the presumed origin of the Annelid from the Platyhelminth excretory system, and also with the development of Polygordius (Hatchek) and Lumbricus. In Perichæta the connection between the nephridial tufts of successive segments is not brought about by a continuous longitudinal duct, one on each side of the body, but by numerous tubules which perforate the intersegmental septa. Thus it appears that *the nephridial system of Perichæta consists of a network of tubules.* In this respect Perichæta agrees with the leech Pontobdella, but differs in the presence of numerous nephridiopores in each segment. These facts appear to lend further support to the view that it is possible to derive the Annelid from the Platyhelminth excretory system.

Lang has pointed out that the "secondary" pores by which the excretory organ of the Platyhelminths communicates with the exterior have probably given rise to the nephridial pores in the Annelida; by a subsequent arrangement of these in a metameric fashion, and by the breaking up of the nephridial network, the paired nephridia have originated. The longitudinal canal has disappeared, except in the cases that I have already mentioned. In some Platyhelminths the longitudinal canals are, partly at least, broken up into a network; and it is this condition which has persisted in Perichæta and Pontobdella; moreover, in some Platyhelminths, where the "secondary" pores have become metamerically arranged, there are more than one pair to each "segment." For this reason it is perhaps allowable to regard the condition of the nephridia in Perichæta as more archaic than Pontobdella. The disappearance of the connection between the nephridia of successive segments leads to the condition which exists in Acanthodrilus; the reduction of the external pores, already perceptible in the posterior segments of *A. multiporus*, culminates in the disappearance of all but two in each segment. The irregularity in the position of these, which is best marked in Plutellus, is the last trace of the presence of multiple nephridiopores in each segment.

Royal Meteorological Society, January 18.—Mr. W. Ellis, President, in the chair.—The paper read was on the non-instrumental meteorology of England, Wales, and Ireland, by Mr. G. M. Whipple. This is a discussion of the observations of wind, cloud, thunderstorms, hail, snow, &c., made at the stations of the Royal Meteorological Society during the eight years 1878–85, and published in the *Meteorological Record*. The S.W. wind is the most prevalent, and blows on the average seventy-four days in the year; the W. wind occurs almost as frequently, blowing sixty-five days. The least dominant winds are the S.E. and N., which occur on twenty-seven days, and the N.E. on thirty-two days. Thunderstorms are most frequent in the eastern and midland counties, and least frequent in the north of Wales.—After the reading of this paper, the annual general meeting was held. The report of the Council showed the Society to be in a satisfactory condition, the number of Fellows being 522.—Mr. Ellis in his Presidential address reviewed briefly the work and position of the Society, remarking that such a Society, whilst unable to carry out expensive original or experimental work, could yet act with great advantage in inciting volunteer workers throughout the country to united action, of which one recent example was the ready response to the request of the Society for photographs of lightning, an excellent collection of which had been obtained, and which would shortly be exhibited; in addition to which arrangements were being made for the more systematic observation of thunderstorms. Referring to the question of sympathetic relation between sunspots and magnetism and meteorology, he thought that any complete treatment of the question in its meteorological aspect seemed to require that it should be dealt with in a much more comprehensive manner than before, for which purpose observations more completely covering the surface of the globe might be necessary, if indeed not necessary also for the solution of many other meteorological questions, the present meteorological stations being distributed over the earth in such isolated clusters. The attention given to synoptic charts was most important, but the general meteorological characteristics of places should also still continue to be studied. After remarking upon other matters, he laid before the meeting tables showing the monthly means of amount of cloud from observations made in three different series at the Royal Observatory, Greenwich, extending in all from 1818 to the present time. In concluding, Mr. Ellis said that at one time the science of meteorology seemed likely to form an exception to the general rule of advance, for more than any other it has required the united action of many workers, but the field of inquiry of late years opened out allows us already to talk of the new or modern meteorology, phrases typical of the advance achieved, although the knowledge gained seems only to remind us of how much has yet to be done.—The following gentlemen were elected the officers and Council for the ensuing year:—President: Dr. Wm. Marcet, F.R.S. Vice-Presidents: Francis Campbell Bayard, William Ellis, Charles Harding, Richard Inwards. Treasurer: Henry Perigal. Trustees: Hon. Francis Albert Rollo Russell, Stephen William Silver. Secretaries: George James Symons, F.R.S., Dr. John William Tripe. Foreign Secretary: Robert Henry Scott, F.R.S. Council: Hon. Ralph Abercromby, Robert Andrew Allison, M.P., Edmund Douglas Archibald, William Morris Beaufort, Henry Francis Blanford, F.R.S., Arthur Brewin, George Chatterton, William Henry Dines, Henry Storks Eaton, Baldwin Latham, Edward Mawley, Dr. Charles Theodore Williams.

Chemical Society, December 15, 1887.—Mr. William Crookes, President, in the chair.—The following papers were read:—An apparatus for comparison of colour-tints, by Alfred W. Stokes.—The alloys of copper and antimony and of copper and tin, by E. J. Ball.—The constitution of the so-called mixed azo-compounds, by Francis R. Japp, F.R.S., and Felix Klingemann.—The interpretation of absorption-spectra, by G. H. Bailey.—The reduction of potassium bichromate by oxalic acid, by C. H. Bothamley.—The reduction of chlorates by the zinc-copper couple, by C. H. Bothamley and G. R. Thompson.—Preliminary notice on the oxidation of oxalic acid by potassium dichromate, by Emil A. Werner.—Isomeric change in the naphthalene series; No. 1, by Henry E. Armstrong.—Isomeric change in the naphthalene series; No. 2, β-Ethoxynaphthalenesulphonic acids, by E. G. Amphlett and Henry E. Armstrong.—Isomeric change in the naphthalene series; No. 3, β-Chloronaphthalenesulphonic acids, by Henry E. Armstrong and W. P. Wynne.—Isomeric change in the naphthalene series; No. 4, α-Haloidnaphthalenesulphonic acids, by Henry E. Armstrong and S. Williamson.—The sulphonation of naphthalene, by Henry E. Armstrong and W. P. Wynne.

Entomological Society, January 18.—Fifty-fifth aniversary meeting.—Dr. D. Sharp, President, in the chair.—An abstract of the treasurer's accounts was read by Mr. H. T. Stainton, F.R.S., one of the auditors; and Mr. H. Goss, the Secretary, read the Report of the Council.—It was announced that the following gentlemen had been elected as Officers and Council for 1888:—President: Dr. David Sharp. Treasurer: Mr. Edward Saunders. Secretaries: Mr. Herbert Goss and the Rev. Canon Fowler. Librarian: Mr. F. Grut. As other Members of Council: Mr. Henry J. Elwes; Sir John Lubbock, Bart., M.P., F.R.S.; Mr. Robert McLachlan, F.R.S.; Dr. P. Brooke-Mason; Mr. Edward B. Poulton; Mr. Osbert Salvin, F.R.S.; Mr. Henry T. Stainton, F.R.S.; and Lord Walsingham, F.R.S.—The President delivered an address, and a vote of thanks to him was moved by Mr. McLachlan, seconded by Mr. F. Pascoe, and carried.—A vote of thanks to the Treasurer, Secretaries, and Librarian, was moved by Mr. Kirby, seconded by Mr. Waterhouse, and carried. Mr. E. Saunders, Mr. H. Goss, Canon Fowler, and Mr. F. Grut replied.

Mathematical Society, January 12.—Sir J. Cockle, F.R.S., President, in the chair.—Messrs. J. M. Dodds and G. G. Morrice were elected members, and Mr. E. W. Hobson admitted into the Society.—The following communications were made:—The theory of distributions, Capt. P. A. Macmahon, R.A.—On the analogues of the nine-points circle in space of three dimensions, S. Roberts, F.R.S.—On a theorem analogous to Gauss's in continued fractions with applications to elliptic functions, L. J. Rogers.—A theorem connecting the divisors of a certain series of numbers, Dr. Glaisher, F.R.S.—On reciprocal theorems in dynamics, Prof. H. Lamb, F.R.S.

Mineralogical Society, January 10.—Mr. L. Fletcher, President, in the chair.—The following papers were read:—On the development of lamellar structure in quartz crystals by mechanical means, by Prof. J. W. Judd, F.R.S.—On the polysynthetic structure of some porphyritic quartz crystals in a quartz-felsite, by Colonel C. A. McMahon.—Notes on hornblende as a rock-forming mineral, by Mr. A. Harker.—On the invitation of the President, Mr. Allan Dick, who was present as a visitor, made some remarks on the process of kaolinization, illustrated by models of crystals.

PARIS.

Academy of Sciences, January 16.—M. Janssen, President, in the chair.—Remarks on M. Wolf's last note on the subject of synchronization, by M. A. Cornu. The author is glad to find himself in harmony with M. Wolf on the important points that no synchronizing system is possible without some controlling or regulating apparatus, and that such apparatus forms an essential feature of the systems of Jones and Vérité.—Remarks accompanying the presentation of the third volume of the "Annales de l'Observatoire de Rio Janeiro," by M. H. Faye. This volume, which was presented by the Emperor of Brazil, is entirely devoted to the three Brazilian expeditions sent to the Island of Saint Thomas, Pernambuco, and Punta Arenas (Patagonia) to observe the transit of Venus in the year 1882. From a comparative study of the recorded results, M. Cruls has calculated the solar parallax at 8″·808.—Fresh researches on the phenomena produced by a potent toxic agent, which is constantly emitted with the air exhaled from the lungs of man and other mammals, by MM. Brown-Séquard and d'Arsonval. The experiments here described and made on seven rabbits entirely confirm the conclusions already announced regarding the powerful character of this volatile organic poison, which appears to be almost certainly an alkaloid. Further researches have been undertaken in order to determine this point by direct proof.—On spontaneous tetanus, by M. Verneuil. A case reported by Dr. Buisson, of Aubechicourt, is referred to as confirming in a striking way the author's opinion that there is no such thing as spontaneous tetanus, and that all reported cases will be found, if carefully studied, to be caused by some virus introduced in some way into the system.—On the canalization of the Isthmus of Panama, by M. de Lesseps. In supplement to his recent remarks on this scheme the author announced that the proposal to establish provisionally a lock canal for one at a dead level has just been adopted by the Company. He further explained how the extensive works already executed can be adapted to the new design, so that the Canal might still be completed and opened for traffic by the year 1890. It would moreover be so constructed that the original plan of a level canal might be gradually carried out without any interruption to the navigation. Both would be of the same length of 74 kilometres, with a breadth of 22 metres at the bottom, and 44 on the surface. Four locks will be needed, each 18 metres wide at the entrance, and with a total length of 180 metres.—On the barometric curves recorded during the third scientific expedition of the *Hirondelle*, by Prince Albert of Monaco. These barometric readings seem to show that the motions of the ship are insufficient to explain the oscillations recorded during the course of a storm, and that these oscillations accompany certain meteorological disturbances without at all aiding to forecast the weather.—On the measurement of the absolute intensity of weight, by M. G. Defforges. The apparatus constructed by MM. Brunner Brothers on the principles here laid down has already been applied with satisfactory results to the measurement of absolute gravity at Paris, Lyons, Dunkirk, Algiers, Laghwat, and Nice.—On elliptical polarization by transmission through metals, by M. Georges Meslin. The author here studies the modifications which polarized light undergoes in its passage through metal plates thin enough to be transparent. As in metallic reflection, the two polarized vibrations in the plane of incidence and in the perpendicular plane undergo in relation to each other a certain retardation, while the rectilinear polarization becomes elliptical.—On the application of the phenomenon of transversal magnetization to the study of the coefficient of magnetization of iron, by M. Paul Janet. This question is here studied by means of a method of mutual induction which presents several advantages over other processes, and which may be easily applied to the study of the influence of the medium in the phenomena of induction.—On the decreasing solubility of the sulphates, by M. A. Etard. The author has already shown that between 103° and 190° C. the sulphate of copper becomes less soluble according as the temperature increases. He now finds that most of these salts undergo a certain disturbance at some point of the line of complete solubility, beyond which point the solubility increases less rapidly and even remains almost stationary. Details are given for the sulphates of zinc, manganese, and potassium.—Symmetric disposition of the centres of the four chief continents, by M. Alexis de Tillo. By graphic processes the author finds that the co-ordinates of the orographic centres of the continents are as under: Asia (with Europe) 43° N., 85° E. of Greenwich; Africa, 4° N., 27° E.; North America, 45° N., 102° W.; South America, 14° S., 56° W. The geometric centre of the Old and New World lies in the region of the Azores and Canaries, and the meridian of Delisle (20° W. of Paris) may in some respects be regarded as the *natural* meridian of the globe.

BERLIN.

Physical Society, December 23, 1887.—Prof. du Bois Reymond, President, in the chair.—Prof. Schwalbe gave a detailed account of the research which Dr. Aubel and Prof. Spring have carried out on the rapidity of the interaction between acids and zinc which is mixed with lead.—Prof. Vogel made a statement of his observations of the solar eclipse of August 19. As is well known, the observations during the whole of the lengthy period of totality were unproductive of results at all stations except those in Siberia—which were not much utilized by observers—owing to unfavourable weather. The speaker appears to have been among the most fortunate at Jurjewetz, where he was stationed in company with the Belgian astronomer Niesten, and the Russian astronomers Kortazzi and Belopolski, for at this place the sun was momentarily visible through the clouds. As a matter of fact, several photographs were successfully obtained, on which, as shown by a specimen exhibited, a corona and several protuberances were visible. These photographs, however, scarcely suffice as a basis for any scientific research. Prof. Vogel had also received a photograph of the eclipse taken in clear weather by an amateur in the Ural Mountains; it showed a complete but small corona, and near it is the image of a star, probably Mercury. Unfortunately no details are given about this photograph. The photographer Karelin has secured some very interesting results at Jurjewetz. This observer, using a very sensitive apparatus, had obtained some very successful photographs of the lunar eclipse, which had taken place about a fortnight before the solar eclipse. The plates were only exposed for 1/60 of a second, and working upon this experience he obtained photographs during the solar eclipse by a similar exposure of 1/60 of a second. The results were quite satisfactory, and from this the important conclusion may be arrived at that exposures of the above very short duration may be used during future solar eclipses. Herr Karelin has further taken a photographic landscape during the eclipse, and from a comparison of the time necessary to obtain this with the time required by the speaker's son to obtain a similar picture during full moon, the speaker concluded that the brightness during the solar eclipse was fifty-six times as great as that of the full moon. Prof. Vogel had intended to photograph the spectrum of the corona, but was not successful in his attempt. He further exhibited a photograph of the spectrum of pure oxygen contained in a Geissler tube and made luminous by the sparks from a battery. The photograph was then photographically enlarged, so that it could readily be seen by a large audience at the same time, and in this form it showed the red and green line, together with a long series of bands and lines extending far into the ultra-violet region. Many of the lines described by Dr. Schuster as single could be seen to be double in this photograph. One of the chief things shown by the enlarged photograph is that the oxygen-spectrum of the positive pole, and of the negative pole, as well as the spark-spectrum of the oxygen itself are here combined into a single spectrum. The speaker intends to apply this method of magnifying the photographs to the spectra of other gases, and thus make the enlarged spectra accessible for teaching purposes in the form of diagrams.

January 6.—Prof. du Bois Reymond, President, in the chair.—Prof. Oettingen, of Dorpat, spoke on the explosion of a mixture of hydrogen and oxygen obtained by electrolysis. As is well known, Bunsen has advanced the following view, based on his experiments, on the explosion of electrolytic gas: by the explosive union of the oxygen and hydrogen, when the spark is passed, a temperature of 3000° C. is produced, the water formed being at once dissociated at this temperature; the temperature of the mixture of gases formed by the dissociation then falls, whereupon a new union between the two takes place, and so on; hence the explosion of electrolytic gas is to be regarded as made up of a series of partial explosions following each other in rapid succession. The speaker had intended several years ago to subject Bunsen's theory to an experimental investigation, and hoped to be able to analyze the phenomenon by the use of a rapidly revolving mirror. As a matter of fact, when the mirror was rotated at a suitable speed, the image observed was not that of a single narrow strip of light, but was rather of considerable width; it was not found possible to interpret this image, notwithstanding that the somewhat complicated experiments were repeated many times. An endeavour was next made, with the assistance of a photographer, to obtain a record of the image, which was equally unsuccessful. He then underwent a course of photographic study; and when he had acquired sufficient experience, he last year repeated his former experiments, with a positive result, using the new methods of sensitizing the plates for the less refractive parts of the spectrum, and the most sensitive possible dry plates. The speaker had further shown, by a spectroscopic examination of the light emittted during the explosion of electrolytic gas, that the light is due, not to the combustion of the gases, but of sodium, which is doubtless accounted for by the incandescence of small particles of glass torn off by the passage of the sparks. He hence introduced, in accordance with the method of Dewar and Liveing, portions of finely powdered salts of various metals, such as copper, zinc, lithium, and cadmium, &c., into the eudiometer in which the explosion of the electrolytic gas was to be made, and now obtained, not only excellent spectra of the respective metals, but also quite distinct photographs of the images in the rotating mirror. A plane mirror was used, placed at fixed distances from the eudiometer and camera, which projected the images of the successive events taking place during the explosion on to the flat sensitized plate. The speaker exhibited a series of the photographs thus obtained: these presented the following appearances, most clearly when the salt used was chloride of copper. In the first place, a bright point, corresponding to the place of passage of the spark, from which a short bright ray passed both upwards and downwards in the tube; then secondly, at a fixed distance from this and occupying the whole length of the eudiometer, a bright image intersected lengthways from end to end by zigzag lines and transversely by parallel sinuous waves. The speaker interpreted the above images by referring the intersecting zigzag lines to a series of waves of impulse caused by successive explosions; he considered on the other hand that the sinuous waves are due to the small particles of the metal which are set in motion by the impulse waves, and hopes to render this explanation still more probable by a new series of experiments on the explosion of carbon-disulphide. According to Prof. Oettingen, the experiments of Berthelot, and Vieille, and of Mallard and Lechatelier, have no bearing upon the explosion which he has studied, occurring as it does in a few thousandths of a second, but refer to the combustion which occurs subsequently to the explosion.—Dr. Kötter spoke on the problem of determining the pressure exerted by the earth, discussed the difficulties in the way of estimating the pressure which the earth exerts upon a wall built into it, and stated the limits within which some theoretical calculations may be relied upon.—Prof. Schwalbe announced that he is engaged in drawing up a Greek nomenclature in connection with physics, and invited the members of the Society to communicate to him any expressions borrowed from Greek which are either rare or difficult to understand.

Meteorological Society, January 3.—The President, Prof. von. Bezold, opened the meeting with a short speech in memory of the late member of the Society, Prof. Kirchhoff, whose many-sided works had not been without importance to the science of meteorology.—The Secretary then made his report on the activity of the Society during the past year, and on the establishment of new meteorological stations in connection with the circle of such stations surrounding Berlin promoted by the Society.—At the election of officers which then followed Dr. Vettin was chosen as President, and Prof. Von Bezold as Vice-President.—Dr. Hellmann spoke on the meteorology of the Iberian Peninsula. During a prolonged stay in Spain in the years 1875-76, the speaker was unable to study the rainfall of the country owing to insufficient data. Since then, however, some 760 annual statements have been published from 70 stations, so that he was now in a position to work out the rainfall, and he presented the results of this in the form of a chart, which formed the basis of his communication. The local distribution of rainfall is very varying. In the district of the Ebro and the whole of the south-east part of the country as far as Carthagena and Old Castile, the rainfall is very slight, the annual fall being about 270 mm.; on the other hand, on the west coast, and in the district of the Pyrenees, the rainfall is considerable, presenting a fall of some 1600 mm. per annum. The maximum fall is found in Serra da Estrella, where it amounts to 3500 mm. The course of the lines of equal rainfall of 300, 400, 600, 800, 1000, and 1600 mm. per annum is extremely curious, and was carefully discussed by the speaker. Two sections through the peninsula, on which the rainfall was represented by ordinates, showed how steep the gradients are when passing from the west coast towards the interior. The speaker threw a good deal of interesting light on the close connection which exists between the agricultural and social conditions of the inhabitants and the rainfall. It appeared that very profound differences have developed themselves between the districts where the rainfall is great and small, and in the latter where the district is well supplied with water or not, these differences completely governing the character and mode of life of the inhabitants. All the stations in common showed a minimal rainfall in the summer, occurring in the months of July and August. In the most southerly stations this minimum falls to 4 mm. for the above two months, whereas in the north-west it rises to more than 100 mm. The curve of maximal rainfall shows three typical forms and three transitional forms. One set of stations shows a maximum in winter, another set has its maximum in the spring, and the third shows it in the autumn, and between these three a graduated transition is observed. The quotient $\frac{\text{maximum}}{\text{minimum}}$ increases rapidly on going south. The difference in the amount of rainfall per annum could only be calculated for thirty-two stations, since it must be based on the records of ten consecutive years at least. The ratio of the extreme to the mean annual rainfall in the north-west, as well as in Central Europe, was two, while in the interior of the country this ratio rose to five. The rainstorms are rarely continuous; they occur chiefly in the morning, and are followed by sunshine: three days of continuous rain, or even of clouds, scarcely ever occur in the whole of Spain. This statement was confirmed by the records of the autographic sunshine recorder. Snow rarely falls in the Iberian Peninsula; the maximum fall of twenty-two snowy days was observed at a station on the upper Douro. At the southern stations snow falls once in thirty years, and it never falls at all at many stations. It is impossible to give any account here of the large mass of further details which the speaker brought before the meeting; they will shortly be published by him in a very extended form.

STOCKHOLM.

Royal Academy of Sciences, January 11.—An account of a memoir by Prof. Ewart, of Edinburgh, on *rigor mortis* and its relation to the putrefaction of fish, by Prof. Smith.—A report of the work done by the Swedish Ornithological Society, by the same.—On the organs and modes of attachment of the marine Algæ, by Count H. Strömfelt.—Mycological studies in Jemtland, by Dr. E. Henning.—On freshwater Algæ from Spain, by Miss M. Lewin.—Astrophotometric studies, by Dr. Charlier.—On the conductibility of illuminated air, by Dr. S. Arrhenius.—Remarks on the paper of Prof. Hoppe, "Zur magnetelectrischen induction," by Dr. Mebius.—On electric currents caused by mechanical pressure, by M. P. A. Siljeström.—Some derivates of naphthostyrite, by Dr. Ekstrand.—On barysite, a silicate of lead from the mines of Harstig, by Messrs. Sjögren and Lundström. On the recent remarks of M. Lebesconte concerning the Cruziana, by Prof. Nathorst.—Demonstration of some propositions of the theory of the elliptic functions, by Dr. Falk.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Institute of Actuaries' Text-book; Part 2, Life Contingencies; G. King (Layton).—Geography for Schools; Part 1, Practical Geography: A. Hughes (Clarendon Press).—Histoire des Sciences Mathématiques et Physiques, tome xii.: M. Marie (Gauthier-Villars, Paris).—The Elements of Graphical Arithmetic and Graphical Statics: J. Y. Gray and G. Lowson (Collins).—Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs; Erster Band, Protozoa, 35 to 41 Lieferung (Williams and Norgate).—Dynamics and Hydrostatics: R. H. Pinkerton (Blackie).—The Farmers' Friends and Foes: T. Wood (Sonnenschein).—Annuaire de L'Observatoire Royal de Bruxelles, 1888, 55 Année (Bruxelles).—Prodromus of the Zoology of Victoria, Decade xv.: F. McCoy (Trübner).—Pflanzenleben. i. Band: Kerner von Marilann (Leipzig).—Le Climat de la Belgique: A. Lancaster (Bruxelles).—Tableaux Résumés des Observations Météorologiques faites à Bruxelles (Bruxelles).—Untersuchungen über die Schneegrenze im Gebiete des Mittleren Innthales: F. R. Kerner von Marilann (Wien).—Journal of the Chemical Society, January, and Supplementary No. (Gurney and Jackson).—Transactions of the Seismological Society of Japan, vol. xi. (Yokohama).—Journal of the Society of Telegraph-Engineers and Electricians, vol. xvi. No. 68 (Spon).—Botanische Jahrbucher für Systematik, Pflanzengeschichte, und Pflanzengeographie, Neunter Band, iii. Heft: Dr. A. Engler (Williams and Norgate).—Actes de la Société Helvétique des Sciences Naturelles, Locle 85 (Neuchâtel).

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